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MODELLING OF A CONVEYOR AND MATERIAL OPTIMIZATIONAL ANALYSIS OF A CONVEYOR ROLLER

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ABSTRACT

In industries, it is very necessary to move the components from one area to the other in a regular basis. So, it is necessary to minimize the workers involved in it. So, here we have designed a conveyor which can be used in industries. It is capable of sending a material from one to place to other by many means. So, it is necessary to found a way to transmit the materials from one place to another within the industry. So, here we have made a conveyor model which is used for the material transformation from one end to another. Here we have designed a conveyor model with a base plate, four pillars for the stand. There will be bearing blocks provided for the rollers to be rolled. A fabric type conveyor belt is mounted on the two rollers, such that it will roll on the rollers. A motor is attached to the one end of the roller to make the roller to run as the conveyor. A pillar is provided to mound the motor for running the conveyor.

The main objective of this study is to explore the analysis of a roller. This has entailed performing a detailed static analysis. The study deals with static analysis.

A proper Finite Element Model is developed using Cad software Pro/E Wildfire 4.0. In this project we are doing the material optimization of roller. This project we are designed the 3D model of the axle by using pro-e software and the analysis taken by different materials of the roller and the analysis taken by the ansys software. This project we are analysing the rotational velocity and moment acting on the roller by the two materials. Presently the bearing are made by the material of stainless steel, this project we are testing the same load under another material.

KEYWORDS: conveyor, bearing blocks, analysis, Pro/E Wildfire 4.0, Finite Element Model.

INTRODUCTION:

Conveyors are essential to productivity, from light-duty package-handling roller conveyors in distribution centers to overhead and towline chain conveyors carrying automobiles through assembly to massive ore-handling belt conveyors. To avert production stoppages due to conveyor failure, progressive companies use predictive condition monitoring technologies to monitor those assets. The objective is to detect impending failures before they occur, and take corrective action during scheduled production shutdowns. One of those technologies is thermograph, or IR Imaging. Thermal imagers capture two dimensional images representing the apparent surface temperatures of conveyor components, and are excellent tools for monitoring conveyors.

Overland Conveyor Design:

- Static and dynamic analysis
- Complete design specifications
- Control theory
- Feasibility studies and cost estimation
- Terrain modeling with earthwork optimizations
- Rubber viscoelasticity for accurate power predictions
- Commercial software for conveyor design

MATERIALS AND METHODS:

A conveyor belt (or belt conveyor) consists of two or more pulleys, with a continuous loop of material - the conveyor belt - that rotates about them. One or both of the pulleys are powered, moving the belt and the material on the belt forward. The powered pulley is called the drive pulley while the unpowered pulley is called the idler. There are two main industrial classes of belt conveyors; Those in general material handling such as those moving boxes along inside a factory and bulk material handling such as those used to transport industrial and agricultural materials, such as grain, coal, ores, etc. generally in outdoor locations. Generally companies providing general material handling type belt conveyors do not provide the conveyors for bulk material handling. In addition there are a number of commercial applications of belt conveyors such as those in grocery stores.

The belt consists of one or more layers of material they can be made out of rubber. Many belts in general material handling have two layers. An under layer of material to provide linear strength and shape called a carcass and an over layer called the cover. The carcass is often a cotton or plastic web or mesh. The cover is often various rubber or plastic compounds specified by use of the belt. Covers can be made from more exotic materials for unusual applications such as silicone for heat or gum rubber when traction is essential.

Material flowing over the belt may be weighed in transit using a beltweigher. Belts with regularly spaced partitions, known as elevator belts, are used for transporting loose materials up steep inclines. Belt Conveyors are used in self-unloading bulk freighters and in live bottom trucks. Conveyor technology is also used in conveyor transport such as moving sidewalks or escalators, as well as on many manufacturing assembly lines. Stores often have conveyor belts at the check-out counter to move shopping items. Ski areas also use conveyor belts to transport skiers up the hill.

A wide variety of related conveying machines are available, different as regards principle of operation, means and direction of conveyance, including screw conveyors, vibrating conveyors, pneumatic conveyors, the moving floor system, which uses reciprocating slats to move cargo, and roller conveyor system, which uses a series of powered rollers to convey boxes or pallets.

The problem of testing the resistance of conveyor belts against perforation is very difficult because the belt consists not only of textile carcass, but also of materials with hyper elastic properties (rubber). The general scheme of problem solving in the program ANSYS is visible in the General scheme of problem solving in the ANSYS program Mathematical modeling means the usage of the mathematical formulas and relations in order to simulate the real situation. For example it is the simulation of the conveyor belt strains. Various parameters, for example size of density and deformation in \ the point of force application etc. can be the results of modeling. The all calculation is made by computer program that is based on finite – element method. Much lower costs are one of the advantages of mathematical modeling, especially in comparison with other methods (for example the experimental research). The next big advantage is based on the possibility of input data changes and on the very fast solutions of various versions of the given problem. . Mathematical model of conveyor beltWe can see, in the previous scheme, that the first step of solution is the model building, or its import from specialized software. In this step, we create geometrical shape of final model called solid model. The next step is the choice of element and the definition of material properties (physical, technological and mechanical properties). The element type determines, for instance, whether the final model is plane (2-D) or space (3-D). The element HYPER58 was selected to model the cover layers of a conveyor belt. It is 8-node element given for the 3-D modeling of a solid hyper elastic structure. It is used for material modeling which is nearly uncompressible (for example rubber and similar materials with great displacements and deformations). Meshing the model. It is a process in which the MKP model is built from the solid model. We need to choose suitable size and number of particular elements because the solution must be as exact as 3D mathematical model of conveyor belt... 183 possible, but at the same time the calculation must not be much longer in consequence of a large number of the elements. Material properties of particular elements are given in the Input data for mathematical model Rubber cover layers Textile carcass

Hyper elastic material constants

A = -0,52MPa

B = 1,477 MPa

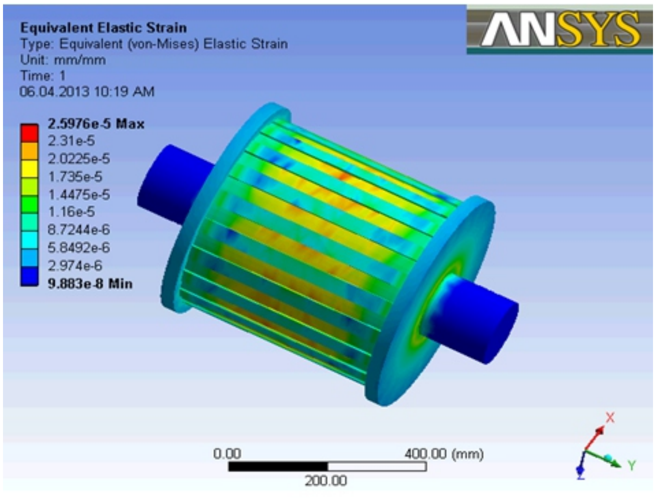
Poisson's number

μ = 0,499

Rubber density

ρG = 1150 kg.m-3

Modulus of elasticity for belt P 1000/4



E = 5500 MPa(according to the STN 26 0378)

Modulus of elasticity for belt P 2000/4

E = 9000 MPa(according to the STN 26 0378)

Poisson's number

μ = 0,3

Textile carcass density

ρK = 1100 kg.m-3

Material Properties of Existing System:
We normally use stainless steel or mild steel for the manufacturing of a conveyor roller. The properties of stainless steel are given below:

Stainless Steel > Constants

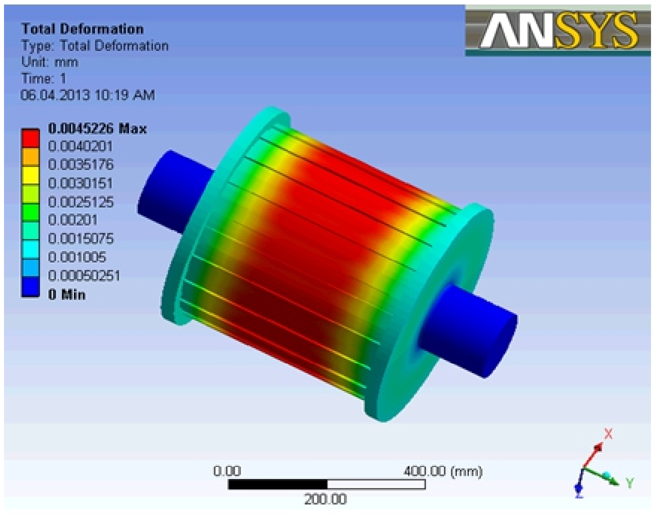
Structural	
Young's Modulus	1.93e+005 MPa
Poisson's Ratio	0.31
Density	7.75e-006 kg/mm³
Thermal Expansion	1.7e-005 1/°C
Tensile Yield Strength	207. MPa
Compressive Yield Strength	207. MPa
Tensile Ultimate Strength	586. MPa
Compressive Ultimate Strength	0. MPa
Thermal	
Thermal Conductivity	1.51e-002 W/mm·°C
Specific Heat	480. J/kg·°C
Electromagnetics	
Relative Permeability	10000
Resistivity	7.7e-004 Ohm·mm

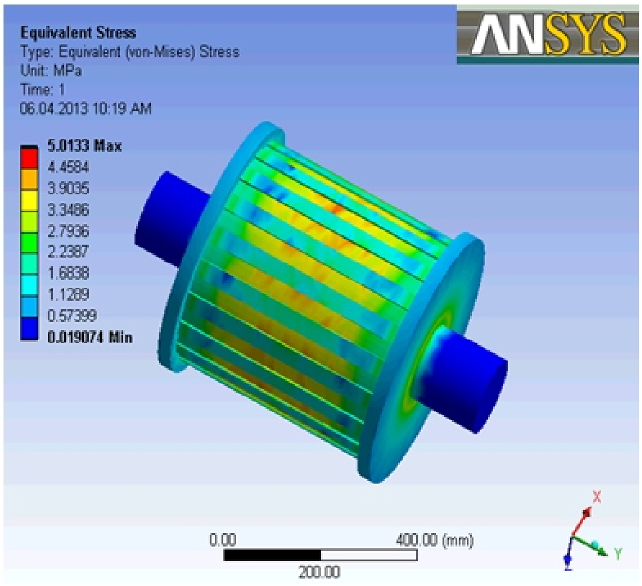
Material Properties of Proposed System:

CARBON FIBRE(HIGH MODULUS) > Constants

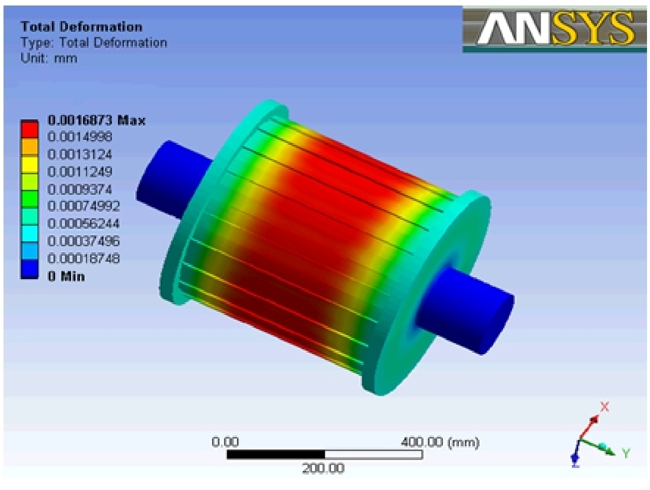
Structural	
Young's Modulus	4.e+005 MPa
Poisson's Ratio	0.36
Density	6.e-006 kg/mm³

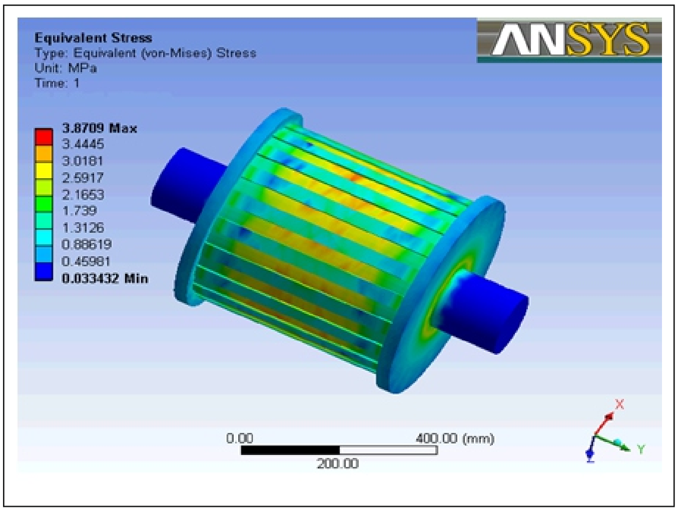
RESULTS:





Stainless Steel	Minimum	Maximum
Total deformation	0	0.0045226
Equivalent elastic strain	9.883e-8	2.5976e-5
Equivalent stress	0.019074	5.0133





Carbon Fiber:

Carbon Fibre	Minimum	Maximum
Total deformation	0	0.0016873
Equivalent elastic strain	8.358e-8	9.6771e-6
Equivalent stress	0.033432	3.8709

CONCLUSIONS:

Experimental results from testing the conventional roller (stainless steel)and optimized roller (carbon fibre (H.M)) under rotational velocity, moment are listed in the Table. Analysis has been carried out by static structural. The stainless steel material is used as a conventional. The results for static structural such as total deformation, equivalent elastic strain, and equivalent stress are determined. Comparing the optimized roller and the conventional roller, optimized roller has good physical properties. Hence it is concluded optimized roller is suitable.

The project carried out by us will make an impressing mark in the industrial field. This project we are study about the roller.

While carrying out this project we are able to study about the 3Dmodelling software (PRO-E) and Study about the analyzing software (ansys) to develop our basic knowledge to know about the design.

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